

Spectroscopy of the hyperfine structure in muonium

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The muonium atom is a bound state of a positive muon and an electron, and is one of the hydrogen-like atoms which consists purely of leptons. By measuring the muonium hyperfine structure, the muon mass and the magnetic moment ratio of the proton to the muon can be determined. These values are used to determine the experimental value of muon $g-2$, for which a discrepancy of 4.2σ between the experimental and theoretical values in the Standard Model has been reported [1], and the importance of these measurements is increasing. We plan to measure the hyperfine structure of muonium with ten times higher precision than the previous experiment by [2] using high-intensity muon beam at J-PARC [3]. For zero-field measurements, a new analytical method called Rabi-oscillation spectroscopy has been developed, the gas pressure shift dependence has been improved using gas mixtures. Also for high-field experiments, high-precision magnetic probes have been developed. In this talk, we will report on these developments and preparations.

[1] T. Albahri et al., (The Muon $g-2$ Collaboration) Phys. Rev. A **103**, 042208.

[2] W. Liu et al., Phys. Rev. Lett. **82**, 711-714.

[3] S. Kanda et al., Phys. Lett. B **815**, 136154.